

must take exception. Mr. Pumpelly's attitude with regard to prehistoric chronology is indicated by the remark with which he introduces his description of the sub-Glacial period in Central Asia. "Remember," he says, "that while we look, in our time-perspective, millenniums are as seconds." This generous and imaginative method of treating the lapse of time, which is no doubt a very necessary virtue in the geologist, is wholly destructive of an accurate chronology in archæological study. Moreover, the attempt to apply geological methods of dating to the purely artificial growth of a city site is totally unscientific, and we are glad to note from a remark at the end of Mr. Pumpelly's preface that he has already realised the possibility of error in at least one of his assumptions. Such dates as 8000 B.C., which he suggests for the beginning of the Neolithic settlement at North Kurgan, or 5000 B.C., for the beginning of the Copper age in South Kurgan, are wholly fanciful. It is true that very early dates were at one time in

#### SOURD MILK: ITS NATURE, PREPARATION, AND USES.

THERE seems to be little doubt that as age advances the microbial flora of the human intestine, especially of the lower portion or large intestine, often undergoes a change both in the number and in the character of the micro-organisms present. From middle life onwards the number of microbes increases, and species capable of inducing putrefactive decomposition of proteins become more abundant. This change can be roughly gauged by making microscopical preparations of the dejecta and staining by the Gram process, a selective method by which certain organisms only are stained. In the child's dejecta Gram-staining microbes are relatively scanty and are mostly *Bacillus bifidus* and *B. acidophilus*, and it is noteworthy that these are lactic-acid producing bacilli. In and after middle life Gram-staining forms usually become more and more numerous, the Gram-staining species now being principally *Bacillus putrificus* and *B. Welchii*, bacteria which induce marked putrefactive decomposition of proteins.<sup>1</sup> In unhealthy conditions of the intestinal tract somewhat similar changes or various abnormal fermentations may occur.

Metchnikoff<sup>2</sup> in a study of the nature of senility formulated the hypothesis that it is caused, partially at least, by auto-intoxication, poisoning by the absorption of products derived from the action of micro-organisms in the digestive tract. Such poisons would be the products of the putrefactive decompositions brought about by the micro-organisms named, and also bodies belonging to the phenol series which are formed by the action of *Bacillus coli*, which is always present in the intestines, becomes more and more numerous from youth to old age, and which also multiplies excessively in unhealthy conditions of the digestive tract. In seeking for some agent which would combat the multiplication of micro-organisms in the intestine, particularly these harmful

forms, Metchnikoff conceived that lactic acid, which has no deleterious action in the human economy, would probably effect the end desired, since the growth of these bacteria is inhibited by a moderate percentage of this acid. Bienstock, for example, found that the *B. putrificus* is inhibited in growth by *B. coli* thanks to its acid-producing power, the acid formed, though small in amount, being lactic acid. Simply to introduce the acid as such would, however, be of little use, for it would be absorbed and decomposed long before it reached the large intestine. Metchnikoff therefore sought for some means whereby lactic acid might be formed *in situ*, and naturally fell back on the use of lactic-acid-producing bacteria, which, if they could be established in the large intestine, might there produce sufficient lactic acid to inhibit the growth of the putrefactive and other deleterious forms. But the problem was not an easy one, for it entailed the finding of a lactic acid ferment which would grow at body tem-

<sup>1</sup> Herter, "Bacterial Infections of the Digestive Tract," 1907.

<sup>2</sup> "On the Prolongation of Human Life."

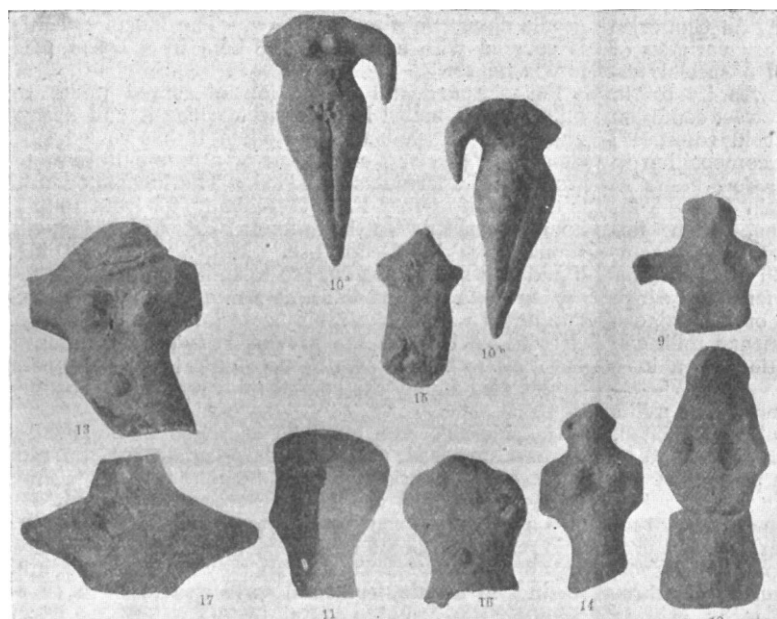


FIG. 3.—Terracotta figurines from the Copper Age Stratum (Culture III), at Anau, suggesting a cultural connection with Babylonia. From the South Kurgan.

vogue, both in Egyptian and more particularly in Babylonian archæology; but these are now given up, and it is recognised that the earliest Sumerian remains in Babylonia do not date from an earlier period than the end of the fourth millennium B.C., while the Neolithic remains at Susa are probably not of a very much earlier period. While these facts naturally affect the dates suggested by Mr. Pumpelly for the cultures at Anau, they do not in any way upset their relative arrangement. It is perhaps significant that Dr. Schmidt nowhere mentions a date; and throughout the whole work the material is presented in such a way that the student is in no way hampered or misled.

The success of the expedition, and the admirable volumes which set forth its achievements and results, are a striking testimony to Mr. Pumpelly's enthusiasm and powers of organisation, and at the same time show the high scientific aims and standards which inspire American archæological and geological research at the present time.

L. W. KING.

perature (99° F.) and maintain itself in spite of the competition of the other micro-organisms present. The ordinary lactic acid ferments found in milk grow best at 75°-85° F., and are unsuitable.

Metchnikoff says<sup>1</sup> "I had no illusion as to the difficulty sure to be encountered in any effort to introduce lactic microbes into the intestinal flora which has been preoccupied by a multitude of other microbes. To make surer of the result, I chose the lactic microbe which is the strongest as an acid producer. It is found in the *Yoghurt*, which originates in Bulgaria. The same bacillus has also been isolated from the *leben* of Egypt; and it is now proved that it is found in the curdled milk of the whole Balkan peninsula, and even in the Don region of Russia." Metchnikoff also noted that some of those who consumed a diet of little else than the soured milk lived to an advanced age. This then was the origin of the use of Bulgarian sour milk, and of the introduction of artificial substitutes for the natural article. It may be added that the use of sour milk seems to be widespread in the East, for it is found also in Turkey, Siberia, and Asia Minor, and in India under the name of "Dadhi."<sup>2</sup> As Chaterjee says, "The extensive use of one or other varieties of fermented milk, produced by means of a special ferment in Eastern countries, probably owes its origin to the difficulty of preserving milk in a sweet condition for a long time, in comparison to cold countries; milk when undergoing spontaneous decomposition in hot climates becomes changed within a few hours to a foul-smelling fluid in which the casein and the fat have undergone liquefaction, whereas, when fermented by means of the special ferment the decomposing, gas-producing, proteolytic bacilli are killed off by the more vigorous organism of the ferment, which has no destructive action on the fatty or albuminous constituents of milk, so that by this means milk can be kept in a condition fit for consumption for a long time."

The bacteriology of the various natural sour milks is somewhat complex and not yet fully elucidated, although considerable research has been devoted to it. Micro-organisms of a peculiar type are present in all. One of the first to be isolated was the *Bacillus bulgaricus*, a large Gram-staining, non-sporing, rod-shaped organism, which grows best at temperatures between 110° F. and 120° F. Development, however, is slow even at the optimum temperature, taking three days for the maximum production of lactic acid in milk, and it is therefore unsuited for the preparation of artificial soured milk. Another organism is the "granule bacillus" (*Körnchenbacillus*) of Kuntze. This is probably the organism so often spoken of as the "bacillus of Massol," and is widely used for the preparation of soured milk, as it grows rapidly and well at a temperature of about 100° F. and produces a relatively high percentage of lactic acid. The name of "granule bacillus" is derived from the fact that granules which stain deeply are present in the bacterial cell. In all the natural soured milks somewhat similar micro-organisms are to be found. It is of interest that Kuntze has suggested that these Bulgarian lactic ferments are allied to the *B. acidophilus* and *B. bifidus*, which, as already stated, are present in the child's intestine, and they are probably primarily of intestinal origin.

In natural sour milks the special lactic acid ferments are always associated with other ordinary lactic acid bacteria, particularly a *Streptococcus* (*S. lacticus*), and a mixed culture of this last-named organism with the bacillus of Massol, presents advantages over the

use of the latter alone.<sup>1</sup> For instance, when the *B. bulgaricus* grows alone in milk it has some effect on the fat, producing small quantities of nauseous tasting substances, but Metchnikoff has shown that this result is entirely obviated by a symbiotic growth with an ordinary lactic acid organism. The ingestion of milk soured by an ordinary lactic acid organism also tends to produce in the intestine an acid environment which favours the growth and persistence of the special lactic ferment, the bacillus of Massol.

Various procedures are adopted for the preparation of the natural sour milks. According to one account, *Yoghurt* is prepared by boiling milk until it has diminished to half its volume by evaporation, it is then allowed to cool somewhat and a little of a previously prepared sour milk is added and the whole allowed to stand in a warm place until next day. Another method is to wipe round a wooden bowl with a piece of cheese (presumably prepared with the sour milk) and then to introduce into the bowl the boiled milk. *Dadhi* is prepared by boiling milk for some time, cooling to blood-heat, and then inoculating with a needle dipped in a former brew. The inoculated milk is covered with a blanket and kept in a warm place for 12 hours.

For the artificial production of soured milks the milk is well boiled in order to sterilise it and destroy undesirable organisms, and when it has cooled sufficiently a "starter" consisting of a pure culture of the proper lactic ferments is added. The inoculated milk is then kept at 100° F. or thereabouts for from 10 to 24 hours, according to the amount of starter added, and should then be fit for use. Many "starters," both liquid and solid (tablets), are to be had, but only a few are to be recommended, as some are grossly contaminated with undesirable bacteria. Another method is to add a little of the previous day's preparation to the milk to be soured. Some of the large dairy companies also supply the soured milk ready for consumption.

Considerable care must be exercised in preparation to use sterilised vessels and to safeguard the milk from contamination during incubation. The milk properly prepared should be thoroughly curdled, possess a not unpleasant tart flavour, and have a marked acid reaction. Some of the older "starters" contained sporing bacilli which though they curdled the milk (owing to tryptic ferments) gave rise to little or no acidity. Preparations containing a combination of the bacillus of Massol, with *Streptococcus lacticus* or *lebenis*, are probably the most suitable.

The internal administration of tablets, &c., containing the lactic ferments, in place of the soured milk, is of questionable utility.

Although some are still sceptical as to the value of soured milk, it can hardly be doubted that it is beneficial in many complaints.<sup>2</sup> Among these are (a) those depending on abnormal putrefaction of proteins in the intestinal tract, and including certain cases of acute enteritis and acute and chronic colitis; (b) auto-intoxication, with products of intestinal putrefaction, as in many cases of general failure of health in elderly persons, forms of anæmia, neurasthenia, with flatulent dyspepsia, &c.; in minor ailments such as lassitude, headache, some forms of constipation and diarrhoea, rheumatic pains, and the like, benefit frequently results. It must also be recognised that even if the soured milk as such does little good, it often enables an addition of valuable and easily assimilable

<sup>1</sup> *Century Magazine*, November, 1909, p. 56.

<sup>2</sup> Chaterjee, *Ind. Med. Gazette*, September, 1909, p. 329.

<sup>1</sup> "On the Bacteriology of *Yoghurt*," &c., see Luerssen and Kühn, *Centralbl. f. Bakt.*, Abt. II, xx., 1908, p. 234; Kuntze, *ib.*, xxi., 1908, p. 737; White and Avery, *ib.*, xxv., 1909, p. 161; Hastings and Hammer, *ib.*, xxv., 1909, p. 419. Full references to the literature of the subject are given in these papers.

<sup>2</sup> Herschel, *Proc. Roy. Soc. Med.*, January, 1910.



food-stuff to be made to the diet by its use. On the other hand, soured milk is by no means a universal panacea, and should not be taken indiscriminately without medical advice, as it sometimes disagrees.

Moreover, the home preparation of soured milk cannot be recommended unless it is undertaken by a member of the household having some knowledge of the scientific principles involved in the practice of sterilisation and use of pure cultures.

R. T. HEWLETT.

#### CLASSICS AND SCIENCE IN EDUCATION.

THE recent correspondence in *The Times* on the question of "compulsory Greek" at Oxford chiefly refers to academic expediency and the establishment of a *modus vivendi* between the Oxford tradition and the claims of scientific students. But the vital and ultimate question is not this detail of practical politics; it is the question of the fundamental principles of education. The recrudescence of the "Greek controversy" is important, as showing how social evolution is gradually forcing education—however unconscious educationists may be of the fact—along the lines of progress.

The issue at Oxford is between the classical or "literary" test, as a guarantee of the classical or "literary" foundation (or "character," it may be said) of the whole system of Oxford studies, and the interests of "the large body of scientific and other workers to whom literary studies are difficult and tiresome, and to whom the examination in Greek is a mere 'obstacle.'" We quote the words of Prof. Turner; he adds that, in his opinion, "Greek is as important to a literary education as mathematics to a scientific. In neither case is the particular study essential, but it is of vast importance." Dr. Jackson points out that "in many of the university studies the highest proficiency cannot be obtained without a knowledge of Greek. For the highest proficiency in mathematics or any branch of science Greek is not, but modern languages are, a necessity."

In connection with this reference to proficiency, a proposal was recently made that Greek should be retained where it is essential for a complete mastery of the subject, but that where it is not essential an alternative which ensured a certain amount of "literary culture" might be allowed.

Such a test is meant to safeguard the Oxford principle of a "literary" or humanistic foundation for all its studies. With this principle is supposed to be bound up "the Oxford spirit."

If this principle is interpreted to mean that the study of science, for example, should be preceded or accompanied by a training in the arts of language which are necessary for complete power of expression and for the development of that side of the mind which is built up by language, the principle is sound. But if it is made to mean the educational necessity of "culture," in the sense of a literary, rhetorical, or æsthetic habit of mind or refinement of "taste," one must protest. The former has no general applicability to education; it is merely a result of specialising upon literary, rhetorical, or æsthetic material. As for the latter, mental refinement is as much a result of scientific as of literary or classical studies. It is a manifestation of the critical, that is, of the scientific habit.

As a test of this, a general training in science would be at least as effective as the study of a special subject such as Greek. And, to take another point of view, a study of physical phenomena and of their relation to human life and history is essential to both complete mental development and a liberal education. To confuse these last with a "literary" or humanistic

tone or curriculum is to confuse general development and general education with specialisation.

Greek is essential to a study of literature or to a complete literary training, but to nothing else. But even supposing that it were necessary for a liberal education, and therefore desirable for scientific students, it is obvious that the standard of Greek required for entrance at Oxford is ludicrously inadequate; it is absolutely no test of anything except of a *beginning* in the study of a particular language.

It is as well to be clear on the meaning of the term "literary." As used in this controversy and with reference to the "Oxford spirit," the term implies rather that form of liberal education which consists mainly in a rhetorical philosophy of politics, history, law, and literature than a literary education proper. Even for this form of liberal education a knowledge of the Greek language, however high the standard attained, would not be essential. Greek, as we have said, is only essential to a literary training proper.

Again, whether used for this or for any purpose, it is useless unless it reaches a high standard. To reach such a standard is itself specialisation, and would require so much time that a boy would be unable to learn with any efficiency any other subject. That is to say, he would have to devote to the study as much time as those boys who enter for classical scholarships. Greek, be it understood, implies Latin. The abolition of Latin as well as of Greek is hardly dreamt of as yet.

Prof. Murray, who thinks that the vital point is "the maintenance of both Greek and Latin—but a better as well as an easier Greek and Latin," is assisted by the classical reformers. These are applying new systems, the most important of which is known as the Frankfurt scheme, for the production of better classical results in half the time. Thus, whereas in the old English public-school system a boy took about ten years to attain proficiency, but by no means adequate proficiency, in two dead languages which he never learned to speak, under the Frankfurt scheme, the first three years, say from nine to twelve, are chiefly devoted to obtaining a good grounding in French instead of in the acquisition of Greek and Latin grammar. Then, and not until then, is Latin commenced; Greek is commenced two years later.

On these lines a great deal of experiment is being made in English schools. Much ingenuity is also being shown in methods for quickening and improving the assimilation of Greek and Latin—the oral method, the heuristic, the principle of learning translation from the very beginning instead of after a long training in grammar, and so on. But it is noteworthy that towards the end of the course the classical time-table becomes excessive again.

It does not seem to have occurred to educationists that possibly the only way of learning a foreign language is by speaking it, and that the best results are obtained by learning the vernacular first. There is a further possibility awaiting realisation, namely, that the study of any other language than the vernacular is a case of specialisation. It follows that the imposition of Latin or Greek or French on the curriculum of young boys is at least premature. In time, lastly, we may come to realise that "no man fully capable of his own language ever masters another," or, at any rate, that for the purposes of a general preliminary education or propædæutic (as contrasted with specialisation), not only is the vernacular sufficient if properly taught, but that the learning of another language or languages while the vernacular is in process of formation is so far from being